REMARKS

In the office action, the Examiner rejected claim 15, finding it unclear what additional step in the method is being sought. This objection has been obviated by appropriate amendment. In particular, "showing motion" was replaced with "highlighting movement."

In the office action, the Examiner rejected claims 1-31 pursuant to 35 U.S.C. § 101 because the claims lack a tie to an apparatus, and fail to provide a useful, tangible concrete result. However, each independent claim recites a transformation of data into a visual depiction. Claim 1 recites a method for medical imaging, comprising displaying a plurality of images from data representing a patient. Claim 16 recites highlighting pixels in a sequence of images associated with a physiological cycle. Claims 17 and 28 recite acquiring ultrasound data and generating images. As provided in <u>In re Abele</u>, 684 F.2d 902 (CCPA 1982) and noted in <u>In re Bilski</u> (pages 25-26), electronic transformation of the data itself into a visual depiction that represents physical objects or substances is sufficient transformation for patentable subject matter.

In the office action, the Examiner rejected claims 1, 4, 6-13, 15-20, and 23-31 pursuant to 35 U.S.C. §102(e) as being anticipated by Kaufman, et al. (U.S. Patent No. 7,295,693). Claims 2, 3, 5, 21, and 22 were rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over Kaufman, et al. in view of Phillips (U.S. Patent No. 6,210,334). Claim 14 was rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over Kaufman, et al. in view of Chiang, et al. (U.S. Patent No. 6,969,352).

Applicants respectfully request reconsideration of the rejections of claims 1-31, including independent claims 1, 16, 17, and 28.

Independent claim 1 recites identifying a phase of a cyclically varying imaging parameter relative to a physiological cycle for each of a plurality of spatial locations in each of a plurality of image frames, the phase for at least one of the spatial locations in a first image frame different than the phase for another of the spatial locations in the first image frame, the cyclically varying imaging parameter having continuity of starting and end points in a parameter cycle; displaying a plurality of images corresponding to the plurality of image frames, each of the plurality of images associated with a different time within the

physiological cycle and representing at least a two-dimensional region of a patient; and highlighting spatial locations in a first image of the plurality of images associated with a first phase and spatial locations in a second image of the plurality of images associated with a second phase, the second phase different than the first phase and the second image corresponding to the different time than the first image.

First, Kaufman, et al. do not identify a phase of a cyclically varying imaging parameter relative to a physiological cycle for each of a plurality of spatial locations in each of a plurality of image frames, the phase for at least one of the spatial locations in a first image frame different than the phase for another of the spatial locations in the first image frame. Kaufman, et al. generate a pixel intensity signal of sliced images by summing the pixel intensities within a selected region for each slice in a direction that is perpendicular to the slice direction (col. 14, lines 50-53). The intensity signal of the sliced images is filtered through a derivative filter to determine which slice images correspond to which phases of a heart (e.g., the diastole phase) (col. 16, lines 19-22). Kaufman, et al. do not identify phases of an imaging parameter for respective spatial locations in each image. In addition, Kaufman, et al. do not disclose that the phase for at least one of the spatial locations in an image is different than the phase for another of the spatial locations in the ***same*** image.

Second, Kaufman, et al. do not highlight spatial locations in a first image of the plurality of images associated with a first phase and spatial locations in a second image of the plurality of images associated with a second phase, the second phase different than the first phase and the second image corresponding to the different time than the first image. Kaufman, et al. draw a boundary around a region of the image of the heart to see and track differentially the motion of the heart through the different portions of the heart cycle (col. 18, lines 57-60). Kaufman, et al. also disclose highlighting the projection of the heart in which a marked region of the heart is at its largest size (claim 4). Kaufman, et al. provide a sequence of images, each with a different sized or shaped boundary and each representing a different part of the heart cycle. The boundary in a given image is based on the location of heart tissue, not the phase of an imaging parameter (e.g., intensity) for the spatial location. The phase may be different for different images, but the phase information is not used for

determining the boundary or other highlighting. Kaufman, et al. do not highlight spatial locations based on the phase of an imaging parameter associated with each spatial location.

Independent claim 16 recites identifying a phase of a cyclically varying imaging parameter relative to a heart cycle for each of a plurality of spatial locations in each of a plurality of image frames, the phase for at least one of the spatial locations in a first image frame different than the phase for another of the spatial locations in the first image frame, the cyclically varying image parameter having continuity of starting and end points in a parameter cycle; and highlighting pixels in a sequence of images responsive to the plurality of image frames, the highlighting shifting between images of the sequence as a function of a shifting phase interval. Accordingly, claim 16 is allowable for the same reasons as claim 1.

Independent claim 17 recites matching a sinusoid waveform with the ultrasound data for each of the pluralities of spatial locations over the physiological cycle, the sinusoid waveform matched for one of the spatial locations at a first time different than the sinusoid waveform matched for another one of the spatial locations at the first time. Kaufman, et al. perform on the intensity signal of the images either a Fourier analysis (col. 15, lines 4-38) or derivative filtering by analyzing zero crossing intervals (col. 16, lines 19-22, 46-48). Fourier analysis or derivative filtering does not necessitate matching a sinusoid waveform with the ultrasound data for each of the pluralities of spatial locations. In addition, before Kaufman, et al. perform either a Fourier analysis or derivative filtering, the intensity signal of the images is generated by summing the pixel intensities within the selected region for each slice (col. 14, lines 50-53). Kaufman, et al. do not disclose that the matched sinusoid waveform for one of the spatial locations at a first time is different than the sinusoid waveform matched for another one of the spatial locations at the first time.

Claim 17 also recites isolating information associated with at least one frequency band from information associated with a different frequency band for each of the plurality of spatial locations as a function of the matched sinusoid for the respective spatial location, and adding information from the different frequency band to the isolated information. As the Examiner notes, Kaufman, et al. fail to mention the use of harmonic isolation above that of the fundamental (Office Action, 9/22/2008).

Independent claim 28 recites matching a sinusoid waveform with the ultrasound data for each of the pluralities of spatial locations, and isolating information associated at least one frequency band from information associated with a different frequency band for each of the plurality of spatial locations as a function of the matched sinusoid; and isolating information associated with at least one frequency band from information associated with a different frequency band for each of the plurality of spatial locations. As discussed above for claim 17, Kaufman, et al. do not disclose these limitations.

Dependent claims 4, 6-13, 15, 18-20, 23-27, and 29-31 depend from the independent claims, and so are allowable for the same reasons as the corresponding base claims. Further limitations patentably distinguish from the cited references.

Claim 4 recites identifying the phase for single pixels. Kaufman, et al. sum the pixel intensities to generate a pixel intensity signal of the images before extracting time information (col. 14, lines 50-53).

Claim 10 recites highlighting movement of a mechanical heart contraction wave during the physiological cycle being a heart cycle. Kaufman, et al. do not highlight movement of a mechanical heart contraction wave, but highlight projections of the heart at a time in which a selected region is at its largest size (claim 4).

Claim 15 recites highlighting movement associated with a sick portion of the heart. Kaufman, et al. do not highlight movement associated with a sick portion of the heart, but highlight projections of the heart at a time in which a selected region is at its largest (claim 4).

Claim 23 recites generating images of intensities as a function of time responsive to adding information from a different frequency band to isolated information. Kaufman, et al. generate a pixel intensity signal of the images, which is a function of the slice number (col. 14, lines 50-58, FIG. 12). Additionally, the Examiner notes Kaufman, et al. fail to mention the use of harmonic isolation above that of the fundamental (Office Action, 9/22/2008). Kaufman does not generate images responsive to adding information from different frequency bands.

Claim 2 recites identifying a phase of a cyclically varying imaging parameter by matching a sinusoid to variation in B-mode values during the physiological cycle, and

identifying a phase of the sinusoid relative to the time within the physiological cycle. Claim 5 recites displaying a plurality of images corresponding to the plurality of image frames by generating B-mode images.

Phillips implements a B-mode processor in the ultrasound system (col. 4, lines 35-39). Filtered data may be sent to the B-mode processor (col. 13, lines 21-27). However, Phillips does not disclose nor teach that during B-mode processing, the phase for at least one of the spatial locations in a first image frame is different than the phase for another of the spatial locations in the first image frame. Kaufman, et al. or Phillips do not disclose nor teach highlighting spatial locations in a first image of the plurality of images associated with a first phase and spatial locations in a second image of the plurality of images associated with a second phase, the second phase different than the first phase and the second image corresponding to the different time than the first image.

Claim 21 depends from claim 17, which recites isolating information associated at least one frequency band from information associated with a different frequency band for each of the plurality of spatial locations as a function of the matched sinusoid for the respective spatial location. Phillips teaches imaging of small vessels using phase inversion to separate the fundamental and even harmonic spectra (col. 3, lines 59-60, FIG. 2), and implementing filters to reduce clutter energy associated with moving tissue (col. 5, line 30-col. 6, line 33). Additionally, Phillips uses processors applying Doppler frequency domain analysis to isolate even harmonic frequencies within the Doppler domain (col. 7, lines 10-15). Phillips does not disclose nor teach isolating information as a function of the matched sinusoid for the respective spatial locations.

Claim 14 recites synchronizing with a pacemaker. Chiang, et al. merely note use of an imaging device for pacemaker monitoring or cardiac rhythm management. There is no suggestion in Chiang, et al. or Kaufman, et al. that the phase for at least one of the spatial locations in a first image frame is different than the phase for another of the spatial locations in the first image frame. In addition, Kaufman, et al. or Chiang, et al. do not disclose nor teach highlighting spatial locations in a first image of the plurality of images associated with a first phase and spatial locations in a second image of the plurality of images associated with

a second phase, the second phase different than the first phase and the second image corresponding to the different time than the first image.

CONCLUSION:

Applicants respectfully submit that all of the pending claims are in condition for allowance and seeks early allowance thereof.

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